Y. M. Faleeva, V. A. Lavrenov, V. M. Zaichenko

Experience in a two-stage pyrolytic conversion of wood sawdust into synthesis gas
Two-stage pyrolytic conversion principle

Biomass → \textbf{PYROLYSIS} → Solids (charcoal), liquids (vapors), gases → \textbf{CRACKING in a fixed bed at \textasciitilde 1000°C} → Synthesis gas, Charcoal
Total electrical efficiency*: 15…19 %

* for different scenarios, based on gas-piston IC engine efficiency 28 %, taking into account own unit needs in electric power (from 10 to 30 %).
Experimental data

Raw materials: wood, peat, straw, sunflower husk, chicken litter, sewage sludge, other.

H₂/CO by vol.: 1.0–2.0
Gas yield: 1.0–1.4 m³
Gas LHV: 9–11 MJ/m³
Efficiency: 63–74 %

Specific tar content for chips (□) and bark (■) at different cracking temperatures
Biomass type: wood chips.
Capacity: 5–15 kg/h (m.c. 10 %).
“PiroEnergy-5”

Pyrolysis reactor. AISI 304 stainless steel. Welded spiral ribs.

Cracking reactor. Ni-Cr-Al alloy.

High-temperature flue gases pipelines. AISI 314 stainless steel.
“PiroEnergy-5”

Feeder. Patented feeding system: gas removing channels form in briquette.

Feeder-side view (left) and pyrolysis-reactor-side view (right).

“PyroEnergy-5” for 5–15 kg of raw material per hour. The next one is “PyroEnergy-75” now under development.
“PiroEnergy-5”

5x4.5x1.5 m frame (V. Lavrenov on photo).

Thermal insulation of cracking reactor.

Thermal expansion compensation.
“PiroEnergy-5”

Control cabinet.

SCADA interface.
Almost a year of intensive research has passed. During the search of the temperature limits some parts of the installation has to be replaced. We continue to search for optimal solutions.
Conclusions

The advantages of developed two-stage pyrolytic process:

• high specific gas yield up to 1.4 m$^3$/kg,

• total volume fraction of combustible components more than 85 %, low concentration of CO$_2$,

• high LHV up to 11 MJ/m$^3$,

• low tar content (less than 20 mg/m$^3$), no liquid products.

The reported study was funded by RFBR, project number 20-08-00835.
Thank you!

Vladimir A. Lavrenov
Senior researcher, PhD
Joint Institute for High Temperatures
of the Russian Academy of Sciences

v.a.lavrenov@gmail.com